

The background of the cover is a close-up photograph of a woman with reddish-brown hair and blue eyes, wearing black-rimmed glasses. She has her mouth wide open, sticking out her tongue, and is making an 'L' hand gesture with her right hand. The overall tone is playful and surprising.

RR



REASON & REVELATION

A Monthly Journal of Christian Evidences

SEPTEMBER 2025 • VOL. 45 • NO. 9

A Mouthful of Proof for God

"Evil"
ANIMAL
Behavior?

NEW
Discovery
Bible Cards



The Human Oral Microbiome: *A MOUTHFUL of PROOF for GOD*

Dave Miller, Ph.D.

IT was September 17, 1683, when Antoni van Leeuwenhoek—now considered to be the “Father of Microbiology”—described the “many very little living animalcules” that he scraped from his own mouth and examined under his microscope.¹ Since that time, the occupants of the oral cavity have continued to be the object of research, with a growing interest being manifested in more recent years by cell biologists, microbiologists, and immunologists.² Though those who have engaged in intensive investigation of the oral cavity often assume an evolutionary origin for the intricacies they observe, in reality, their discoveries constitute astounding evidence for a divine Creator. What follows is but a surface perusal of a small portion of that evidence.

Microbiome and Microbiota

The term “microbiome” was coined in 2001 by Lederberg and McCray.³ With regard to the human mouth, it refers to the entire habitat of the microbial residents of every surface area of the oral cavity. These surfaces are many—including both the top (dorsum) and bottom (ventral) of the tongue, lip, teeth, maxillary vestibule, keratinized gingiva (gums), gingival sulcus (the shallow groove between the gum and the tooth surface), buccal mucosa,⁴ tonsils, hard and soft palates, the throat, saliva, salivary glands beneath the tongue, and even the plaque that forms.⁵ The word “microbiota” refers to the unique combination of

microorganisms that exist within this complex oral topography.

Over 700?

The reader is surely surprised to learn of the sheer number of distinct bacterial species that naturally inhabit the human mouth. While the actual number of bacteria, archaea,⁶ fungi, viruses, and protozoa that inhabit the human mouth is unknown,⁷ “the oral cavity has the second largest and diverse microbiota after the gut, harboring **over 700 species** of bacteria”⁸—“one of the most heavily colonized parts of our bodies.”⁹

These myriad species are not undesirable intruders or invaders. The oral cavity is their permanent home—a home that normally maintains a fairly constant temperature of 98.6 degrees Fahrenheit, providing a stable environment in which to survive.¹⁰ Within the overall oral cavity are “many distinct microenvironments” that provide unique and site-specific advantages for the various species.¹¹ The microbiota unquestionably belong there. In fact, our bodies live in harmony with literally millions of tiny microorganisms that perform a variety of essential functions.

In Harmony?

Do these 700+ species war with each other, making the mouth a biological warzone of conflict and carnage, inflicting sickness and suffering upon the human host? Quite the opposite. In fact, “most of the microorganisms that inhabit

the oral cavity live in a symbiotic relationship.”¹² The symbiotic relationship that they sustain with each other and with their human host enables ongoing fulfillment of mutual benefits.¹³ Indeed, the microbes work in concert with each other to perform very intricate, specific tasks that are useful to the human host, thereby maintaining symbiotic equilibrium in a “mutualistic relationship.”¹⁴ That interaction and balance among oral microorganisms aids the human body in repelling the invasion of undesirable organisms from outside the body.¹⁵ Together they “form highly regulated, structurally and functionally organized communities attached to surfaces as biofilms, with interspecies collaborations as well as antagonisms that contribute to ecologic stability.”¹⁶

As noted, an extensive variety of microbiotas and biofilms, composed of hundreds of species, are scattered among multiple sites of the oral cavity. The species within each biofilm, as well as the other biofilms, all work in harmony—unmistakably **designed to work together** for the common good of human health. Not only do they not harm the human host, their commensal interrelationship helps keep pathogenic species in check.¹⁷ In fact, the microbes within the oral cavity can even aid the body’s immune responses **outside** the oral cavity.¹⁸

That is not to say that the species never conflict with each other: “The relationship between the two bacterial species can be antagonistic or synergistic, depending perhaps on the composition of the remaining species in the biofilm or other environmental conditions.”¹⁹ Thus, even when a “clash” occurs, the overall well-being of the human host is the goal of the interactions and adjustments. Even when the microbiota is “disturbed” by any number of possible circumstances, never-

theless, “the relationship between the oral microbiome and its host is **dynamic** and...the composition of microbial communities is **remarkably stable**.”²⁰

The entrance of pathogens from outside the system can cause problems—which immediately elicit the attention of the microbiota. In fact, due to “the interplay of the host’s immune system with its microbial symbionts, acute infections of the oral mucosa are **rather rare**.”²¹ Not only does the oral mucosa²² serve as a physiological barrier, “the functions of immune networks within this mucosa reflect the site-specific challenges faced within the oral cavity” with the ability to “trigger immune responses to the development of pathologic microbial communities.”²³ The oral cavity is conspicuous for its “specialized immune-cell networks” that possess the exceptional capability to respond to the constantly fluctuating environmental conditions by means of “tissue-specific cues and exclusive immunologic responses that are **tailored** to the oral cavity.”²⁴

However, as is typically the case, we humans are “our own worst enemy.” We can be responsible for instigating the instability of our own oral microbiome. Scientists list a number of factors that interfere with that stability and hamper the effectiveness of microbial communities. These culprits include poor oral hygiene, excessive use of antibiotics, modern diet trends, alcohol, and tobacco.²⁵ Incredibly, researchers have come to believe that disrupting the delicate balance of our oral microorganism residents can contribute to additional bodily ailments, including asthma, diabetes, allergies, cancer, and obesity.²⁶ What’s more, while various types of toothpaste typically reduce harmful bacteria, they can also suppress the beneficial bacteria. Likewise, mouthwashes that claim to kill

99% of bacteria would seem to be at variance with what scientists have discovered concerning the crucial role played by the oral microbiome. Mouthwashes can also significantly reduce the ability of saliva to serve as a buffer against tooth decay and disease.²⁷ In fact, some studies suggest that the use of antibacterial mouthwash can “increase blood pressure as a result of its inhibitory effect on the oral microbiome.”²⁸

Inter-Communication?

As researchers continue to dig deeper, they discover new layers of complexity. It turns out that the synergism among the microorganisms includes **actual communication** between species by means of QS—“quorum sensing”:

Bacteria within a biofilm can communicate with each other by producing, detecting and responding to small diffusible signal molecules in a process called quorum sensing, which confers benefit for host colonization, biofilm formation, defense against competitors and adaptation to changes in the environment.²⁹

These signaling molecules are secreted by the bacteria themselves in order to engage in nutritional and signaling interactions with other bacteria, thereby acting in concert for the benefit of the human host.³⁰ Such intelligent synergism could not have evolved via mindless happen-

stances of alleged eons of evolutionary time.

Their Purpose?

But what, specifically, do these millions of microorganisms **do**? We are in constant contact with all types of germs, bacteria, and other microorganisms—which enter our mouths. “The oral microbiome... forms an ecosystem that maintains health in a state of equilibrium,”³¹ making it “crucial in maintaining oral as well as systemic health.”³² Scientists have discovered that this complex ecological community performs astonishing activities that regulate oral health, contributing to “critical metabolic, physiological and immunological functions.”³³ Incredibly, though only 1 out of 10 cells in our bodies is human, this prolific microbial society is responsible for performing “many biological functions that we could not perform on our own and protect[s] us from invasion by pathogenic microorganisms.”³⁴ Hence, resident bacteria are “crucial for maintaining homeostasis.”³⁵

Keep in mind that each human body is genetically unique and different from all others. If a supernatural Creator is responsible for the existence of human bodies as well as the multitude of living organisms that inhabit those bodies, one would fully expect to discover symbiotic harmony.³⁶ Such is certainly

Reason & Revelation is published monthly by Apologetics Press, Inc. Periodicals postage paid at Montgomery, AL. **Postmaster:** Send address changes to **Reason & Revelation**, 230 Landmark Dr., Montgomery, AL 36117; **ISSN:**[1542-0922] **USPS#** 023415.

Apologetics Press is a non-profit, tax-exempt work dedicated to the defense of New Testament Christianity. Copyright © 2025. All rights reserved.

Editor & Associate Editor:

Eric Lyons, M.Min.
Jeff Miller, M.S., Ph.D.*
(*Biomechanical Engineering, Auburn University)

Annual Subscription Rates:

\$14.00	Domestic & Overseas (OVERSEAS: ADD SHIPPING)
\$12.00	Domestic Bulk (5+ TO SAME ADDRESS)

Orders, Inquiries, & Address Changes:

Phone: (334) 272-8558
Web: store.apologeticspress.org
E-mail: mail@apologeticspress.org

Discovery—Scripture & Science for Kids is a sister publication for children. For more information, please contact our offices or visit the Discovery website at: www.DiscoveryMagazine.org

the case with the interrelationships among the bacteria and between the bacteria and the human host. Complex relationships between humans and microbes facilitate human health while simultaneously providing the means for the microbes to survive and flourish. Humans and microorganisms literally depend on each other.³⁷

Further, “the variable microbiome...is exclusive to an individual.”³⁸ Consequently, diversity and variation of species within the microbiome are “individual specific and site specific.”³⁹ “Rather than being fixed, the composition of the oral microbiota changes throughout life consistent with the oral cavity being a dynamic microbial environment.”⁴⁰ So the oral microbiota differs from person to person.⁴¹ The microbial communities are programmed to react to varying environmental conditions by “modifying their species composition and population size.”⁴² Some oral bacteria species are site specific at one or multiple sites within the mouth. Others are subject-specific.⁴³

In fact, the bacteria possess on their surface “adhesins.” Adhesins are proteins that enable the bacteria to attach to various surfaces in the mouth. Consequently, the bacteria will select for colonization those oral surfaces that possess complementary receptors that will adhere to and bind with their own specific adhesins.⁴⁴ This site specialization is essential for the formation of a biofilm in which the bacteria can colonize and grow. “Once established, the new community of bacteria then begins the process of replication, maturation, and formation of a complex biofilm that can contain hundreds of species.”⁴⁵

If these striking realities were not enough to convince us of divine design, consider the fact that each species of bacteria can differ markedly in its purpose and function.

As previously noted, some bacteria in the mouth specifically inhibit pathogens, i.e., those bacteria that cause disease. These bacteria resist colonization by pathogens. One species, for example, manifests “direct antagonism against oral pathogens.”⁴⁶ Another such species actually produces hydrogen peroxide in large quantities which, in turn, hampers the growth of a harmful bacterial species.⁴⁷ What’s more, while diet affects the oral microbiome, scientists have come to suspect that it works the other way as well. Oral cavity microorganisms can influence a person’s dietary preferences and, thus, “modulate the expression levels of taste receptors in the mouth.”⁴⁸

Saliva

As an active and integral member of the oral microbiome, the origin of human saliva is inexplicable from an evolutionary standpoint. Its sophistication and complexity alone constitute proof of its divine design. Saliva provides a multi-purpose function for the human mouth and body—including lubrication, temperature, and digestion.⁴⁹ Yet, apart from these vital functions, saliva is a critical and essential component in the efficient functioning of the oral microbiome. It serves as “a protective system that limits the type of bacteria that can live in the mouth.”⁵⁰ “Saliva is used by oral biofilms as a delivery system, bringing nutrients, peptides, and partially dissolved carbohydrates.”⁵¹ Human saliva “keeps the bacteria hydrated and also serves as a medium for the transportation of nutrients to microorganisms.”⁵²

Saliva contains components—including enzymes, proteins, and glycoproteins—that provide the central source of nutrition for microorganisms. As many as 10^8 microorganisms have been found in a single milliliter of saliva—an

average of 100 million bacteria.⁵³ At the same time, saliva also contains elements that possess antimicrobial action.⁵⁴ In addition to these salivary components, the composition of the microbial communities in the mouth are affected by the “variation in the amount and velocity of salivary flow.”⁵⁵ In fact, salivary flow, together with oxygen concentration, nutrient availability, and gingival crevicular fluids, creates “spatial gradients,” that further demonstrate the complicated nature of the oral cavity and its inhabitants’ interaction with the human host.⁵⁶ Together, saliva and bacteria even protect tooth surfaces against acid.⁵⁷ Indeed, saliva’s multi-pronged properties help regulate and maintain a balanced oral microbiome.

CONCLUSION

DESPITE the amazing number of discoveries that have accumulated through the years, despite the progress that has been made in an effort to unravel and understand the marvelous mysteries of the human oral microbiome, when all is said and done, “little is known about the microflora of the healthy oral cavity.”⁵⁸ As always, the ignorance of man must bow to the intricacy and complexity of God’s handiwork.

How may such intricate, complicated, profound, extensive, mind-boggling symbiotic interrelationships be explained from an evolutionary perspective? “Well, over a period of millions of years, humans and the various organisms co-evolved a mutual dependency.” This “explanation” is nonsensical and meaningless. The myriad microorganisms and the human host needed each other **from the beginning** of their existence. How did the hundreds of species come into existence in the first place? How did they then “decide” to find an evolved human and gain

entrance into that human's mouth? How did species that are antagonistic to each other come to inhabit the oral cavity together? Was a microorganism convention conducted to discuss and decide the matter?

FACT: Every single one of these microorganisms—as well as their human hosts—possess concise design variables that **prove** the inability of gradual mutation and natural selection to function as causative agents. Can such design, complexity, order, purpose, and intelligence come out of mindless, evolutionary chaos? To ask is to answer. The Truth: God is the causative agent: “In the beginning, **God created...**”

Virtually with one accord, the scientists who have spent years of their lives exploring the layered intricacies of the human oral microbiome inevitably feel compelled—perhaps unwittingly—to use terminology that tacitly implies its divine intelligent design:

- “the **finely-tuned** equilibrium of the oral ecosystem”⁵⁹
- “the **complex dynamics** and fitness factors of key organisms in oral microbiomes”⁶⁰
- “a **complex** ecosystem whose equilibrium serves as a **remarkable** example of reciprocal adaptation”⁶¹
- “a **staggering** number of species”⁶²
- “**astounding** diversity”⁶³
- “a **complex** ecological community”⁶⁴
- “**exceptionally complex** habitat”⁶⁵
- “**finely tuned...**to protect from disease”⁶⁶

Yet, even in the face of tremendous strides made in recent years to unravel some of the mysteries of these incredibly sophisticated, seemingly innumerable species, researchers acknowledge that the complex processes “**are still not fully understood**”⁶⁷—an understatement if there ever was one.

“Finely-tuned”? “Complex dynamics”? “Remarkable”? “Staggering”?

“Astounding”? “Exceptionally complex”? Follow the logic. To be candid, the human oral microbiome **screams** divine design.⁶⁸ Its complex marvels could not possibly have come about gradually over millions of years via blind, sheer accident. The Creator had to have literally preprogrammed millions of microscopic creatures to live throughout the human oral cavity to perform unending, ongoing tasks for the benefit of those created in His image (Genesis 1:26). The rational, unprejudiced person will surely acknowledge the conclusion that such evidence requires. The psalmist put it this way: “I will praise You, for **I am fearfully and wonderfully made**; marvelous are Your works, and that my soul knows very well” (Psalm 139:14).

ENDNOTES

- 1 Antoni van Leeuwenhoek (1952), *The Collected Letters of Antoni van Leeuwenhoek* (Amsterdam: C.V. Swets & Zeitlinger; Committee of Dutch Scientists), 4:135, https://www.dbnl.org/tekst/leeu027alle04_01/leeu027alle04_01_0008.php#00076; Clifford Dobell (1932), “Letter 39. 17 September 1683. To F. Aston,” *Antony van Leeuwenhoek and His ‘Little Animals’* (New York: Harcourt, Brace, & Co.), pp. 238ff.
- 2 J.A. Gilbert, M.J. Blaser, et al. (2018), “Current Understanding of the Human Microbiome,” *Nature Medicine*, 24:392-400.
- 3 J. Lederberg and A.T. McCray (2001), “Ome Sweet ‘Omics—A Genealogical Treasury of Words,” *The Scientist*, 15[7]:8, [https://pdfs.semanticscholar.org/c06e/c544b5e87e82f7705c401e1eff5cc8e1f780.pdf?ga=2.78678612.1501589133.1598356620-](https://pdfs.semanticscholar.org/c06e/c544b5e87e82f7705c401e1eff5cc8e1f780.pdf?ga=2.78678612.1501589133.1598356620-2085924697.1588006444)

- 2085924697.1588006444.
- 4 The buccal mucosa refers to the lining of the inside of the cheek.
- 5 Priya Nimish Deo and Revati Deshmukh (2019), “Oral Microbiome: Unveiling the Fundamentals,” *Journal of Oral Maxillofacial Pathology*, 23[1]:123,125, January-April; Akshima Sahi (2020), “What Microorganisms Naturally Live in the Mouth?” *News-Medical*, September 16; A. Jörn, B.J. Paster, L.N. Stokes, I. Olsen, and F.E. Dewhirst (2005), “Defining the Normal Bacterial Flora of the Oral Cavity,” *Journal of Clinical Microbiology*, 43[11]:5730, November; M. Kilian, I. Chapple, M. Hannig, P.D. Marsh, V. Meuric, A. Pedersen, M.S. Tonetti, W.G. Wade, and E. Zaura (2016), “The Oral Microbiome: An Update,” *British Dental Journal*, 221:660, November 18.
- 6 Archaea are single-celled microorganisms with structure similar to bacteria.
- 7 Maria Avila, David Ojcius, and Ozlem Yilmaz (2009), “The Oral Microbiota: Living with a Permanent Guest,” *DNA & Cell Biology*, 28[8]:406; Deo and Deshmukh, p. 123.
- 8 Deo and Deshmukh, p. 122, emp. added.
- 9 Kilian, et al., p. 658.
- 10 Deo and Deshmukh, p. 123.
- 11 Lea Sedghi, Vincent DiMassa, Anthony Harrington, Susan V. Lynch, and Yvonne L. Kapila (2021), “The Oral Microbiome: Role of Key Organisms and Complex Networks in Oral Health and Disease,” *Periodontology 2000*, 87[1]:107, October; J.L. Welch, F.E. Dewhirst, and G.G. Borisy (2019), “Biogeography of the Oral Microbiome: The Site-Specialist Hypothesis,” *Annual Review of Microbiology*, 73[1]:335-338.
- 12 Akshima Sahi (2020), “What Microorganisms Naturally Live in the Mouth?” *News-Medical*, September 16.
- 13 Deo and Deshmukh, p. 124.
- 14 Anil Kumar and Nikita Chordia (2017), “Role of Microbes in Human Health,” *Applied Microbiology Open Access*, 3[2]:1; Kilian, et al., p. 655.
- 15 Lu Gao, Tiansong Xu, et al. (2018), “Oral Microbiomes: More and More Importance in Oral Cavity and Whole Body,” *Protein Cell*, 9[5]:488,496.
- 16 Kilian, et al., p. 659.
- 17 Avila, et al., p. 406.
- 18 Sedghi, et al., p. 107.
- 19 Avila, et al., p. 409.
- 20 P.D. Marsh, D.A. Head, D.A. Devine (2015), “Ecological Approaches to Oral Biofilms: Control Without Killing,” *Caries Research*, 49[Supplement 1]:46-54; Kilian, et al., p. 664, emp.

SPEAKING SCHEDULES

Kyle Butt

Sept. 12-14

Charlotte, NC

(256) 232-1096

Sept. 26-28

West Palm Beach, FL

(561) 848-1111

Eric Lyons

Sept. 12-14

Springfield, IL

(217) 585-1803

Sept. 28 - Oct. 2

Bremen, GA

(770) 537-3013

Dave Miller

Aug. 31-Sept. 1

Montgomery, AL

(334) 235-5894

Sept. 21

Soddy Daisy, TN

(423) 903-3689

Jeff Miller

Sept. 5-7

Myrtle Beach, SC

(843) 448-8071

Sept. 28

Montgomery, AL

(334) 264-2985

TRADING CARDS WORTH COLLECTING

FOR MORE INFORMATION, VISIT OUR WEBSTORE AT
APOLOGETICSPRESS.ORG/BIBLE-TRADING-CARDS



SCAN QR CODE TO
ORDER CARDS



AVAILABLE
NOW

APOLOGETICS PRESS DISCOVERY BIBLE CARDS



SINGLE PACK.....\$3.25
• 10 CARDS PER PACK



5-PACK BOX.....\$13.50
• 5 SINGLE PACKS PER BOX
• 50 TOTAL CARDS
• INCLUDES AT LEAST 2
PREMIUM CARDS



40-PACK BOX.....\$100.00
• 40 SINGLE PACKS PER BOX
• 400 TOTAL CARDS
• INCLUDES THE ENTIRE SET OF
365 CARDS, INCLUDING ALL 20
PREMIUM CARDS (PLUS 35
DUPLICATE CARDS)



added.

- ²¹ E. Zaura, E.A. Nicu, B.P. Krom, and B.J. Keijser (2014), "Acquiring and Maintaining a Normal Oral Microbiome: Current Perspective," *Frontiers in Cellular and Infection Microbiology*, 4:85; Kilian, et al., p. 660.
- ²² "The oral mucosa refers to the moist, membrane-like lining that covers the inside of the mouth, including the lips, cheeks, tongue, and floor of the mouth. It is a protective barrier that shields the underlying tissues from injury, infection, and chemical irritants"—"Oral Mucosal Diseases" (2025), UC Davis Health, Department of Dermatology (Sacramento, CA), <https://health.ucdavis.edu/dermatology/specialties/medical/oral.html#:~:text=The%20oral%20mucosa%20is%20the,or%20ulcers%20on%20this%20lining>.
- ²³ N. Dutzan, T. Kajikawa, L. Abusleme, et al. (2018), "A Dysbiotic Microbiome Triggers T_H17 Cells to Mediate Oral Mucosal Immunopathology in Mice and Humans," *Science Translational Medicine*, 10[463]:eaat0797; Sedghi, et al., p. 110.
- ²⁴ Sedghi, et al., p. 110; "Oral Mucosal Immunity and Microbiome" in *Advances in Experimental Medicine and Biology*, ed. G.N. Belibasakis, G. Hajishengallis, N. Bostanci, M.A. Curtis (Cham: Springer International Publishing), 1197, emp. added; R.Q. Wu, D.F. Zhang, E. Tu, Q.M. Chen, W. Chen (2014), "The Mucosal Immune System in the Oral Cavity—An Orchestra of T Cell Diversity," *International Journal of Oral Science*, 6[3]:125-132; A. Esberg, S. Haworth, R. Kuja-Halkola, P.K.E. Magnusson, I. Johansson (2020), "Heritability of Oral Microbiota and Immune Responses to Oral Bacteria," *Microorganisms*, 8[8]:1126.
- ²⁵ Sedghi, et al., p. 113; E. Xiao, M. Mattos, G.H.A. Vieira, et al. (2017), "Diabetes Enhances IL-17 Expression and Alters the Oral Microbiome to Increase Its Pathogenicity," *Cell Host Microbe*, 22[1]:120-128; Mi Klein, L. DeBaz, S. Agidi, et al. (2010), "Dynamics of *Streptococcus mutans* Transcriptome in Response to Starch and Sucrose During Biofilm Development," *PLoS One*, 5[10]:e13478; A. Cekici, A. Kantarci, H. Hasturk, T.E. Van Dyke (2014), "Inflammatory and Immune Pathways in the Pathogenesis of Periodontal Disease," *Periodontology* 2000, 64[1]:57-80; P. De Pablo, T. Dietrich, T.E. McAlindon (2008), "Association of Periodontal Disease and Tooth Loss with Rheumatoid Arthritis in the US Population," *Journal of Rheumatology*, 35[1]:70-76; J. Wu, B.A. Peters, C. Dominianni, et al. (2016), "Cigarette Smoking and the Oral Microbiome in a Large Study of American Adults," *The ISME Journal*, 10[10]:2435-2446; W. Pitiphat, A.T. Merchant, E.B. Rimm, K.J. Joshipura, "Alcohol Consumption Increases Periodontitis Risk," *Journal of Dental Research*, 82[7]:509-513.
- ²⁶ Kumar and Chordia, p. 131.
- ²⁷ Sedghi, et al., p. 121.
- ²⁸ Ibid., p. 113; C.P. Bondonno, A.H. Liu, K.D. Croft, et al. (2015), "Antibacterial Mouthwash Blunts Oral Nitrate Reduction and Increases Blood Pressure in Treated Hypertensive Men and Women," *American Journal of Hypertension*, 28[5]:572-575.
- ²⁹ Y.H. Li and X. Tian (2012), "Quorum Sensing and Bacterial Social Interactions in Biofilms," *Sensors*, 12:2519-2538; Kilian, et al., p. 659.
- ³⁰ W.C. Fuqua, S.C. Winans, and E.P. Greenberg (1994), "Quorum Sensing in Bacteria: The LuxR-LuxI Family of Cell Density-Responsive Transcriptional Regulators," *Journal of Bacteriology*, 176:269-275; Avila, et al., p. 408; Kilian, et al., p. 662.
- ³¹ Deo and Deshmukh, p. 127.
- ³² Ibid., p. 122.
- ³³ Kilian, et al., p. 659.
- ³⁴ Avila, et al., p. 405.
- ³⁵ Kilian, et al., p. 660.
- ³⁶ However, one must keep in mind that through the six thousand years of human history, genetic

degeneration has occurred and the application of the laws of thermodynamics continues to degrade the effectiveness and efficiency of all biological organisms.

- ³⁷ Kumar and Chordia, p. 131.
- ³⁸ Deo and Deshmukh, p. 123.
- ³⁹ Ibid., p. 124.
- ⁴⁰ Sedghi, et al., p. 110.
- ⁴¹ Ibid., p. 112. Also M.W. Hall, N. Singh, et al. (2017), "Interpersonal Diversity and Temporal Dynamics of Dental, Tongue, and Salivary Microbiota in the Healthy Oral Cavity," *NPJ Biofilms Microbiomes*, 3[1]:1-7.
- ⁴² Avila, et al., p. 405.
- ⁴³ Jørn, et al., p. 5724.
- ⁴⁴ R.J. Gibbons (1989), "Bacterial Adhesion to Oral Tissues: A Model for Infectious Diseases," *Journal of Dental Research*, 68:750-760; Jørn, et al., p. 5731; Deo and Deshmukh, p. 123.
- ⁴⁵ P.D. Marsh (2006), "Dental Plaque as a Biofilm and a Microbial Community—Implications for Health and Disease," *BioMed Central*, 6:1-7; B. Rosan and R.J. Lamont (2000), "Dental Plaque Formation," *Microbes and Infection*, 2[13]:1599-1607; Sedghi, et al., pp. 115-116; Welch, et al., pp. 335-338.
- ⁴⁶ Sedghi, et al., p. 113.
- ⁴⁷ Ibid., p. 122.
- ⁴⁸ Ibid., pp. 108,120.
- ⁴⁹ Avila, et al., p. 406; Michael Wilson (2004), *Microbial Inhabitants of Humans* (Cambridge: Cambridge University Press), pp. 318ff.
- ⁵⁰ Maria del Mar Ferrándiz Lorenzo (no date), "Bacteria in Our Mouths: How Many and What are They?" KIN Laboratories, <https://www.kin.es/en/bacterias-que-tenemos-en-la-boca/>.

- ⁵¹ Avila, et al., p. 406. See also P.E. Kolenbrander, N.S. Jakubovics, N.I. Chalmers, and R.J. Palmer, Jr. (2007), "Human Oral Multispecies Biofilms: Bacterial Communities in Health and Human Disease" in *The Biofilm Mode of Life: Mechanisms and Adaptations*, ed. S. Kjelleberg (Norfolk, VA: Horizon Bioscience), pp. 175-194.
- ⁵² Deo and Deshmukh, p. 123.
- ⁵³ Kilian, et al., p. 660; Also Lorenzo.
- ⁵⁴ W. van't Hof, E.C. Veerman, A.V. Nieuw Amerongen, and A.J. Ligtenberg (2014), "Antimicrobial Defense Systems in Saliva," *Mono-graphs in Oral Science*, 24:40-51; Kilian, et al., p. 660.
- ⁵⁵ Sedghi, et al., p. 115.
- ⁵⁶ Ibid., p. 115; D.M. Proctor, J.A. Fukuyama, P.M. Loomer, et al. (2018), "A Spatial Gradient of Bacterial Diversity in the Human Oral Cavity Shaped by Salivary Flow," *Nature Communications*, p. 9.
- ⁵⁷ Kilian, et al., p. 660.
- ⁵⁸ Jørn, et al., p. 5721.
- ⁵⁹ Kilian, et al., p. 657, emp. added.
- ⁶⁰ Sedghi, et al., p. 107, emp. added.
- ⁶¹ Kumar and Chordia, p. 131, emp. added.
- ⁶² Avila, et al., p. 408, emp. added.
- ⁶³ Deo and Deshmukh, p. 123, emp. added.
- ⁶⁴ Kilian, et al., p. 659.
- ⁶⁵ Deo and Deshmukh, p. 122, emp. added.
- ⁶⁶ Kilian, et al., p. 652, emp. added.
- ⁶⁷ Ibid., p. 660, emp. added.
- ⁶⁸ Even as the Universe "declares" (i.e., "announces/makes known") the glory of God (Psalm 19:1). Ludwig Koehler et al. (1994-2000), *The Hebrew and Aramaic Lexicon of the Old Testament* (Leiden: E.J. Brill), p. 766.

Does "EVIL" Behavior in the Animal Kingdom DISPROVE Creation by a GOOD God?

Jeff Miller, Ph.D.



ACCORDING to Darwinian evolution, all species evolved from previous species, beginning with a single-celled organism. As new species emerged, "survival of the fittest" took over—the selfish tooth-and-claw battle for survival. Morality, according to naturalistic evolutionists, is a purely **human** construct.¹ It did not (and could not) have evolved from non-living substances. It only exists in the minds of humans, and right and wrong are purely man's opinion. Right and wrong, therefore, did not **exist** until humans created them. There is no objective right and wrong that is above humanity. Murder, rape, theft,

kidnapping—all "immoral" behavior cannot be said to be inherently wrong if Darwinian evolution is true. Biblical creationists, of course, argue that **objective** morality does, in fact, exist and that it is defined by **God**, not humans.

Naturalistic evolutionists sometimes respond by arguing that, while evolution (namely, "survival of the fittest") can explain natural evil,² if an all-good God designed the Universe, why would there be cases of "natural/biological evil"—that is, "evil" practices in the non-human world? Many creatures do seemingly terrible things. Oxford University evolutionary biologist

Richard Dawkins highlighted that, “The total amount of suffering per year in the natural world is beyond all decent contemplation. During the minute it takes me to compose this sentence, thousands of animals are being eaten alive; others are running for their lives, whimpering with fear; others are being slowly devoured from within by rasping parasites; thousands of all kinds are dying of starvation, thirst and disease.”³ The late Harvard paleontologist, Stephen Jay Gould, stated, “If God is benevolent and the Creation displays his ‘power, wisdom and goodness,’ then why are we surrounded with pain, suffering, and apparently senseless cruelty in the animal world?”⁴ Animals do things that humans would consider barbaric and wicked. In the case of certain microorganisms (e.g., phagocytes), sometimes their only function seems to be to do terrible things to other living things. That seems to be all they were **designed** to do! The sea otter sometimes rapes-to-death juvenile harbor seals. The female black widow spider engages in sexual cannibalism, eating the male black widow after mating. The Emerald cockroach wasp stings a cockroach and implants an egg in it. The cockroach then stays alive as the wasp hatches and eats its way out of the cockroach. In some instances, mother bears, felines, canids, primates, various rodents, insects, fish, amphibians, reptiles, and birds have all been known to eat their offspring. Many primates engage in homosexual behavior. Venom and poison exist; viruses and diseases exist. How can the Creator be good if He designed such creatures? And why would He then proceed to call such behavior “evil” when humans engage in the same things, considering the fact that He actually designed other living things to do those very things? Is not such

behavior hypocritical? How do creationists explain “natural evil”?

First, keep in mind that, according to Scripture, the Earth and its inhabitants are not the same today as they were originally, when God made them. Women go through more pain in childbirth (Genesis 3:16). Plants have changed (Genesis 3:17-18). Animals have changed: all land creatures were originally created to eat only plants, for instance, according to Genesis 1:29-30. The injection of thorns and thistles among plants (Genesis 3:17-18) no doubt affected the dietary behaviors of animals. “The serpent” was cursed to crawl on its belly (Genesis 3:14), possibly referring to all serpents, not merely Eve’s unique tempter. Humans could no longer live forever by having access to the Tree of Life (Genesis 3:19,22). What has happened to effect such seemingly negative changes? Why does “natural evil” exist in the animal kingdom?

FIVE REASONABLE EXPLANATIONS FOR “NATURAL EVIL”

1) Genetic Degeneration

Creation biologists are well aware of so-called biological “evil”⁵ and spend time studying it as well as presenting and writing about it in Bible-based, peer-reviewed science journals and conferences, tracking down what could be going on in each case.⁶ In some cases, such behaviors are the result of genetic degeneration—that is, a creature’s genome mutating over time, causing the creature no longer to behave in the exact manner it was designed by God to behave (e.g., sickle-cell anemia, cystic fibrosis, the Ebola virus⁷, and venom).⁸ The Universe is decaying in keeping with the Second Law of Thermodynamics—the genome included.⁹ As the psalmist said, the Universe and the Earth are growing old like a gar-

ment (Psalm 102:25-26). They are changing and degenerating. Genetic entropy could have changed the behaviors of various creatures over time from the ways they were originally created to behave.

2) Habitat Displacement

In some cases, such behavior could be the result of creatures being displaced from the ideal environment they were designed to inhabit, causing them to behave differently—to react differently to their new environment than they would in their original habitat.¹⁰ Perhaps their original environment no longer exists. The Flood, a natural disaster, or even human activity, could have destroyed their originally designed ecosystem. Perhaps over time a creature was forced to migrate to a different habitat in search of food. If the creature’s new habitat had other stimuli than those of its designed habitat (e.g., different climate, animals, or plants), the creature would naturally respond differently. Once again, animals are not exactly the same as they were when they were created and placed on the Earth. When Genesis 9:2 states that, after the Flood, animals would begin to fear humans, Moses may have been alluding to the impact that the radically different post-Flood Earth would have on animals. After all, “the world that then existed [i.e., before the Flood—JM] **perished**, being flooded with water” (2 Peter 3:6).

3) Offspring Diversification

In some cases, seemingly natural evil could come about due to diversification. This explanation refers to the change that has occurred in animal varieties as they have diversified over time due, for example, to the genetic potential that God built into the genomes of all living creatures (e.g., Genesis 30:37-39). In other words, in some cases, God

did not directly create an animal initially with the behaviors that we witness today. Instead, as living creatures of the Earth have reproduced within their kinds (Genesis 1:24), new varieties within the originally created designs have emerged (e.g., domestic dogs came from wolves, and dozens of domestic dog breeds have since come from the original domestic dogs). As breeding occurs, new behaviors sometimes accompany the new varieties (e.g., compare the innate behavioral differences between dogs such as Pit bulls and Labradors).

4) Human Disobedience

In many cases, examples of “natural evil” could point back to what occurred in Genesis 3. According to verses 17-19, Adam’s sin in the Garden of Eden caused God to punish man by directly cursing the Earth in a way that created difficulty for Adam in providing for his family.

Then to Adam He said, “Because you have heeded the voice of your wife, and have eaten from the tree of which I commanded you, saying, ‘You shall not eat of it’: Cursed is the ground for your sake; in toil you shall eat of it all the days of your life. Both thorns and thistles it shall bring forth for you, and you shall eat the herb of the field. In the sweat of your face you shall eat bread till you return to the ground.”

Eating, which was once easy—reaching up and grabbing fruit from trees—would now require sweat. The ground across the planet was apparently then populated with thorns and thistles due to God’s cursing it (see Genesis 5:29)¹¹, possibly affecting the diets of animals, since many plants would have become difficult to eat. Again, “the serpent” was forced to move on its belly. Genesis 6:12 could be referring, in part, to changes in the animal kingdom initiated by the

curse: by the time of the Flood “all flesh had corrupted their way on the Earth”—which, according to verse 19, may be referring to animals as well as humans. Whether they negatively changed because of God’s activity in the curse or due to their interactions with humans (e.g., from special breeding or mistreatment), human disobedience has no doubt been at the root of many cases of “biological evil.”

Who could know, other than God, what all was directly affected by the curse He brought about on the Earth due to the sin of Adam and Eve? Who could know, besides God, what changes He directly initiated in “every beast of the earth, on every bird of the air, on all that move on the earth, and on all the fish of the sea” after the Flood, causing them to “fear” and “dread” humans (Genesis 9:2)? Were genetic “switches” flipped by God that activated or deactivated certain genes that affected animal behavior? Were certain epigenetic behaviors initiated? Regardless, punishment for the wicked behavior in which all men participate (Romans 3:23) is loving,¹² just,¹³ and even helpful (e.g., Hebrews 12:5-11; Psalm 119:67¹⁴).

5) Original Design

Creationists also do not deny the possibility that, in some cases, a supposed “evil” behavior among the animals could come down to original design. In fact, in one way or another—be it due to God directly cursing the Earth as fair punishment on men or the indirect effects of His actions (or inactions) in the past (e.g., by creating/allowing entropy/degeneration and diversification, and causing/allowing displacement)—God is in some way “responsible” for “natural evil.”

But what is “evil”? Who defines what constitutes “evil,” and is “natural evil” really “moral evil” in that sense? From a biblical perspective,

what is considered “evil” or “good” is defined by God (and only God) and, in essence, their definitions come down to disobedience or obedience to God’s instructions, respectively.¹⁵ One may not like God’s definition of “evil,” but one cannot charge Him with evil actions unless those actions are defined as evil by God. Is “natural evil” really “evil” in God’s sight?

Murder is moral “evil” in God’s sight—He defines it to be so (e.g., Galatians 5:21). However, **killing** is not inherently wrong.¹⁶ It is wrong when it involves the murder of a human, but it is not wrong when it involves human death carried out by man (or God) as God-endorsed capital punishment.¹⁷ Killing is not evil when it is enacted on animals by humans for food (Genesis 9:3; Acts 10:13), clothing (note that God, Himself, used animal skin to make clothes for Adam and Eve—Genesis 3:21) or, before the Christian age, sacrifice. **Nor is it moral evil in God’s sight when animals kill one another.**

As evidence that animals killing other animals is not inherently “evil” in God’s sight, consider the fact that animals apparently were able to die from the beginning (e.g., from killing one another)—before the first sin.¹⁸ Since only those who ate from the Tree of Life could live forever (Genesis 3:22-24), all those who did not partake would eventually die. Animals’ ability to die was apparently part of God’s original design. So, some creatures could have been designed to do things to other living creatures that humans cannot do since, unlike animals, humans are **moral** creatures made in the **image of God** (Genesis 1:26-27).¹⁹ Unlike evolutionary thinking, humans are different. We are not merely “naked apes.” Humans have been given commands by God that animals were not given—commands that, if disobeyed, are defined by God

as “evil.” Animals were not created with souls²⁰ or free will and, therefore, are not capable of engaging in evil behavior in the way humans can. Animals are no more accountable to God for their instinctual behavior than would be a malfunctioning robot. Animals will not be in hell, in spite of the fact that they “murder” and “fornicate” regularly. The fact that humans were made in the image of God, having souls, free will, and a sense of right and wrong, instead of mere instinct, makes humans of “more value” than the animals, as Jesus highlighted in Matthew 6:26-30, Matthew 10:31, and Matthew 12:12. Bottom line: “natural evil” is not really moral evil.

But **why** might God have intentionally **designed** some creatures to behave in ways that would be evil if humans did the same things? First, obviously, if an animal was actually **designed** to behave a certain way, it would be **purposeful** to God. So, there would be a good reason for it. When we consider that *the purpose of the Universe is to provide a place that would be ideal for preparing human souls for the afterlife*,²¹ it opens our minds to possible reasons for those God-engineered designs.

For example: is it true that seeing certain behaviors in the animal kingdom can be **instructive** to humans? Whether a behavior serves as a warning to humans about what a society can look like if we fail to rise above the carnal instincts of the animals, an inspiration to humans about how to behave to have a better life, or an incessant prompt causing us to long for and pursue entrance into that Land where there is no pain, tears, darkness, or death (Revelation 21:4,25), animal behavior can be instructive to humans. No wonder that, repeatedly throughout Scripture, God encourages us to look at His creation to see things He wants us to learn (e.g., Psalm 111:2; Psalm 19:1; Romans 1:20)—from

Job 38-41 to Proverbs 30 to Jesus’ teachings in the Sermon on the Mount in Matthew 6, and dozens of other examples.²²

CONCLUSION

BOTTOM line: there are reasonable explanations for so called “natural evil” in the animal kingdom that prove God is not guilty of moral evil—nor are animals. Humans, on the other hand, **are** guilty of real evil (Romans 3:23), and there are real consequences for that behavior. Attempting to sidestep that truth and reject God, by erroneously charging Him with immoral or hypocritical behavior, will not save a person from his inevitable fate. The payment for moral evil is physical and spiritual death (Romans 5:12)—the eternal separation from God (Isaiah 59:1-2; 2 Thessalonians 1:9) of all humans who fail to take advantage of God’s gift of life, granted only to those who are **in Christ** (Romans 6:23). Are you in Christ?²³ Contact us at Apologetics Press if we can help.

ENDNOTES

- ¹ Charles Darwin (1958), *The Autobiography of Charles Darwin*, ed. Nora Barlow (New York: W.W. Norton), p. 94; Richard Dawkins (2006), *The God Delusion* (New York: Houghton Mifflin), p. 301; William Provine (1998), “Evolution: Free Will and Punishment and Meaning in Life,” <http://eeb.bio.utk.edu/darwin/DarwinDayProvineAddress.htm>; Richard Dawkins (1989), *The Selfish Gene* (Oxford: Oxford University Press), pp. 2-3.
- ² In truth, evolution cannot explain the origin of living creatures at all, much less cases of “natural evil” within the animal kingdom. See Jeff Miller (2017), *Science vs. Evolution* (Montgomery, AL: Apologetics Press); Jeff Miller (2024), “4 Reasons to Believe Evolution Is Not True,” *Reason & Revelation*, 44[8]:2-11, August.
- ³ Richard Dawkins (1995), *River Out of Eden: A Darwinian View of Life* (London: Weidenfeld & Nicolson), pp. 131-132.
- ⁴ Stephen Jay Gould (1982), “Nonmoral Nature,” *Natural History*, 91[2]:19.
- ⁵ Todd Charles Wood and Megan J. Murray (2003), *Understanding the Pattern of Life* (Nashville, TN: Broadman & Holman), pp. 154-167; Paul Garner (2009), *The New Creationism* (Louisville, KY: Evangelical Press), pp. 161-162; Kurt P. Wise (2002), *Faith, Form, and Time* (Nashville, TN: Broadman and Holman), pp. 161-162, 166; Kurt P. Wise (2018), *Devotional Biology: Learning to Worship the Creator of Organisms* (Nashville, TN: Compass Classroom), pp. 109-114.
- ⁶ E.g., J. Francis (2022), “A Creationist Perspective of the Human Virome and Origin of Viral Pathology,” *Journal of Creation Theology and Science Series B: Life Sciences*, 12:1-10; A.S. Rhodes, M.G. Wentley, and J.D. Blaschke

- (2020), “Evidence for a Recent Transition into Parasitism within four Phyla of Marine Animals,” *Journal of Creation Theology and Science Series B: Life Sciences*, 10:1-8; M.G. Wentley, A.S. Rhodes, and J.D. Blaschke (2020), “Community, Autonomy, and the Emergence of Parasitism,” *Journal of Creation Theology and Science Series B: Life Sciences*, 10:1-8; J. Blaschke (2018), “Toward a Young-Earth Model of Parasite Evolution,” *Journal of Creation Theology and Science Series B: Life Sciences*, 8:1-5; J. Blaschke (2014), “Ancestral State Reconstruction as a New Method for Identifying Baramins of Pathogens and Parasites,” *Journal of Creation Theology and Science Series B: Life Sciences*, 4:23-30; Joseph W. Francis and Todd C. Wood (2013), “A Creationist Perspective on the Origin of Pathogenic Vibrio Cholerae and Vibrio Cholerae Toxin (CT),” *Proceedings of the International Conference on Creationism*, Vol. 7, Article 29; Joseph W. Francis (2003), “The Organosubstrate of Life: A Creationist Perspective of Microbes and Viruses,” *Proceedings of the International Conference on Creationism*, Vol. 5, Article 40.
- ⁷ Wood and Murray, p. 162.
- ⁸ Garner, p. 161; Jeffrey P. Tomkins (2015), “Snake Venom, Genetic Entropy, and Adam’s Curse,” *Acts & Facts*, <https://www.icr.org/article/snake-venom-genetic-entropy-adams-curse>.
- ⁹ J.C. Sanford (2008), *Genetic Entropy & the Mystery of the Genome* (Waterloo, NY: FMS Publications).
- ¹⁰ E.g., gut bacteria (Garner, p. 161).
- ¹¹ Is it possible that the rest of the Earth outside of the Garden was already populated with thorns, thistles, and other negative aspects and that Adam and Eve simply did not have to experience those effects since they were in the Garden (i.e., that the “curse” was merely their being forced from the Garden to experience those effects)? Genesis 3:17 explicitly states that the ground was cursed by God due to the sin of Adam and Eve (not because of its original created state). Genesis 5:29 further verifies the fact that God actually changed the nature of the Earth in the curse.
- ¹² Eric Lyons (2008), “Is Punishing Evildoers Unloving?” *R&R Resources*, 7[10]:37R-40R, October.
- ¹³ Eric Lyons (2021), “How Can a Loving God Send Souls to Hell?” Apologetics Press, <https://www.apologeticspress.org/how-can-a-loving-god-send-souls-to-hell/>.
- ¹⁴ See also Proverbs 23:13-14; 2 Chronicles 33:12.
- ¹⁵ E.g., 2 Kings 17:13.
- ¹⁶ Kyle Butt (2009), “Killing, Murder, and the Bible,” Apologetics Press, <https://www.apologeticspress.org/killing-murder-and-the-bible-2794/>.
- ¹⁷ Dave Miller (2012), “God and Capital Punishment,” *Reason & Revelation*, 32[7]:62-71, July.
- ¹⁸ Jeff Miller (2016), “Could There Have Been Any Death Before the Fall?” *Reason & Revelation*, 36[8]:74-80, August.
- ¹⁹ Eric Lyons and Bert Thompson (2002), “In the ‘Image and Likeness of God’ [Part II],” *Reason & Revelation*, 22[4]:25-31, April.
- ²⁰ Bert Thompson and Sam Estabrook (1999), “Do Animals Have Souls?” *Reason & Revelation*, 19:89-92, December.
- ²¹ Dave Miller (2016), “Why People Suffer [Part I],” *Reason & Revelation*, 36[1]:2-11, January.
- ²² Jeff Miller (2025), “Studying Science from a Biblical Perspective,” *Reason & Revelation*, 45[1]:2-5, January.
- ²³ See Kyle Butt (2006), “In Christ,” Apologetics Press, <https://apologeticspress.org/in-christ-1982/>, as well as the 13-lesson series of short videos, “Salvation Matters,” on the Apologetics Press website for an introductory study of the subject.



NOTE FROM

The Editor



AP Staff Spotlight: Jeremy Pate, Youth Publications Coordinator

After spending 18 years in youth and family ministry, Jeremy Pate joined AP as our Youth Publications Coordinator—a role he has flourished in for the past seven years. Jeremy is one of the most hard-working, creative Christians you will ever meet, capable of everything from *writing* a book to *illustrating* it, and from preparing and preaching a great sermon to turning a tedious list of 40 AP camp rules into a memorable rhyme that campers are on the edge of their seats to hear—and perhaps never forget.

Jeremy received his B.A. degree in Graphic Design and Illustration from Middle Tennessee State University in 1997. In 2001, he received his Master's in Ministry from Freed-Hardeman University. In addition to his work at AP, Jeremy also serves as one of the preaching ministers at the Dalraida church of Christ in Montgomery, Alabama, where he also serves as one of the deacons for the College Ministry.

Jeremy is the imaginative mind behind all five of AP's biblically sound, creative VBS curricula. He has dedicated years of his life to delivering high-quality work on some of the best VBS lessons, artwork, PowerPoints, etc., that you will find anywhere. *Flood, Fearless, Operation: Creation, Truth*



Hunters, and *The Name of Jesus* have been used effectively (and to the glory of God!) by numerous congregations around the world.

In 2024, Jeremy became the associate editor of AP's monthly children's magazine, *Discovery: Scripture and Science for Kids*. He also created AP's first-ever Bible board game titled *Truth Hunters*, which can accompany the *Truth Hunters* VBS or serve as a family-fun, stand-alone Bible trivia game.

Jeremy recently completed two projects: AP's new *Discovery Bible Cards* (advertised in this month's *R&R*, and which you do *not* want to miss out on!), as well as a beautiful, 400-page family devotional book, titled *Discovering True Character*, which should be available in the next couple of months. Jeremy is currently working on a few new projects, including helping lead a team effort to create a six-year, 312-lesson Bible curriculum for teens (7th-12th graders), which we expect to release in late 2027 or early 2028.

Finally, if you ever come through Montgomery, Alabama, stop by AP and see us. And be *sure* to visit Jeremy's office—hands down the most kid-friendly, delightfully chaotic office at AP. You won't regret it.

Eric Lyons
Executive Director